

cubic meter swept out by that square centimeter, or, in other words, per each 10 kilometers flight in such cloud. Or, what comes to the same thing, he would have to fly, under these conditions, 72 miles or thereabouts, to accumulate a layer of clear ice an inch thick on the front of the plane. Of course, though, nothing like all the excess vapor encountered would be condensed on the plane. Perhaps not a tenth of it. At any rate, condensation of

the excess vapor in an undercooled cloud can not load an airplane with explosionlike rapidity. In fact the amount of icing from this source probably is negligible.

As stated above, the condensation explanation of the icing of airplanes may seem at first to be sound and sufficient, but like many another explanation that has found its way into popular literature (and some, too, that isn't so popular) it was just jumped at—and missed a mile.

RELATIONS BETWEEN WINTERS IN MANITOBA AND THE FOLLOWING SPRING IN EASTERN UNITED STATES

By FRED GROISSMAYR

[Passau, Germany]

In various publications¹ I have given, as I believe, solid bases for a winter temperature forecast in the interior of Canada from the Winnipeg-Lake region to Saskatchewan; further investigations on Canadian seasonal temperature forecasts had given me the interesting result that the winter temperature at Manitoba is a very useful indicator for the immediately following spring on the Great Lakes province and the New England States as well as for a large area bounded in the west by the Mississippi, in the east by the Atlantic, and in the south about by the thirty-fifth parallel of north latitude. For this investigation I used the 50-year series 1874–1923. The correlations are as follows:

Δt I–II Winnipeg 1873–74 with following Δt III–V: 1874–1923.

Winnipeg	0.59	Detroit	0.43
Marquette	0.63	New York	0.53
Chicago	0.45	Omaha	0.37
Toronto	0.65	Key West	0.00
Albany	0.47	Cheyenne	0.04
Cincinnati	0.39	Portland, Oreg.	0.08
Eastport	0.49	Mobile	0.26
Nashville	0.29	San Diego	0.02
New Haven	0.58	Galveston	0.05
St. Johns	0.31	San Francisco	0.11

A still better combination, however, is Δt I–II Winnipeg 1874–1923 with Δt III–IV: Winnipeg 0.52.

Low to Westward:		High to Eastward—Con.	
Portland	0.11	New York	0.66
Denver	0.16	Albany	0.64
San Diego	0.05	Baltimore	0.63
Galveston	0.06	Pittsburgh	0.51
High to Eastward:		$r \geq 0.60$:	
Marquette	0.74	St. Louis	0.49
Toronto	0.73	Omaha	0.47
Chicago	0.60	Nashville	0.35
Boston	0.66	Mobile	0.32
Eastport	0.51	Key West	0.03
New Haven	0.71		

The next table shows the numerical departure of Δt I–II at Winnipeg and those of Δt III–IV, 1874–1923: (1) For Δt III–IV (Marquette and Toronto divided by 2); (2) for Δt III–IV (New York plus New Orleans, plus Cincinnati and Milwaukee divided by 5).

¹ Relations between summers in India and winters in Canada, Mo. Wea. Rev. 57: 455–56. See also Neue Erkenntnisse im Zusammenhange des Welt-Wetter. Analen der Hydrographie, April, 1930.

Year	Δt I–II Winnipeg	Δt III–IV Great Lakes	Eastern United States	Year	Δt I–II Winnipeg	Δt III–IV Great Lakes	Eastern United States
1874	–0.5	–4.8	–3.3	1901	–0.2	+1.8	–0.6
1875	–11.3	–5.7	–4.2	1902	10.5	+4.6	+1.6
1876	–6.3	–3.0	–2.1	1903	+4.1	+4.8	+3.3
1877	+5.5	–1.5	–1.6	1904	–3.9	–2.2	–1.7
1878	+17.1	+9.0	+5.8	1905	–0.3	+0.3	+2.0
1879	–4.5	–0.1	+0.4	1906	+5.9	+0.1	–1.9
1880	+0.7	–0.6	+0.9	1907	–1.8	–1.0	+0.4
1881	–2.0	–1.6	–3.0	1908	+9.8	+0.5	+3.2
1882	+3.3	+0.1	+2.0	1909	+0.4	–1.2	–0.4
1883	–9.6	–5.5	–1.5	1910	+3.5	+8.0	+5.5
1884	–9.6	–2.3	–0.8	1911	–0.3	+1.6	+0.5
1885	–8.9	–8.1	–3.5	1912	–1.0	–2.3	–1.6
1886	–5.8	+1.1	–0.2	1913	–2.3	+1.0	+0.6
1887	–9.9	–4.0	–0.6	1914	+1.0	–0.6	–1.5
1888	–7.3	–6.3	–1.9	1915	+9.0	+4.8	+0.1
1889	+2.2	+3.0	+1.6	1916	–1.4	–1.7	–1.8
1890	–8.1	–1.2	–1.0	1917	–5.4	–0.7	–0.3
1891	+1.8	–0.3	–0.9	1918	–0.1	+2.8	+1.7
1892	–1.0	–1.7	–2.3	1919	+9.0	+2.4	+1.0
1893	–7.8	–2.8	–0.9	1920	+2.5	+0.1	–1.0
1894	–0.5	+4.3	+3.1	1921	+10.5	+6.5	+6.0
1895	–2.3	–1.5	–0.3	1922	+3.2	+3.2	+2.0
1896	+2.4	+0.1	+0.7	1923	+2.8	–0.7	–3.6
1897	+1.1	+0.8	+0.8				
1898	+5.9	+4.4	+1.0				
1899	–4.3	–1.2	–1.0				
1900	+2.1	–0.4	–0.8				

We further find the remarkable fact, that in all cases, in which the combined January–February temperature at Winnipeg had a pronounced character (departure 6.0; standard deviation 6.01 F.), the following combined March–April in the Lake region as well as in eastern United States had the same departure. In this 50-year series we have 15 *pronounced* Winnipeg January–February departures that is in 30 per cent. In the table I have indicated these by bold-face type.

The correlations: Δt I–II W. with Δt III–IV Lake area or first group is 0.75. For eastern United States or the second group 0.60.

The regression equations are:

First group Δt III–IV = 0.433 Δt I–II W. F.

Second group Δt III–IV = 0.227 Δt I–II W. F.

It is a noteworthy, but notwithstanding physically founded fact, that even the stations in North Dakota, as well as Winnipeg itself, are much less influenced than the far countries on the Atlantic; even New York's March and April temperatures are much more influenced by the preceding Januaries and Februaries in Manitoba,

than the next environs of Winnipeg. For this fact the physical causes are:

(1) High-temperature constancy between I-II and III-IV in Manitoba.

(2) Prevailing northwest winds in Ontario and New England in the early spring.

(3) The thermic effect of the great fresh-water lakes, therefore, we will consider the relations in a cold winter in Manitoba.

Manitoba I-II severe; III-IV cool also Ontario, Michigan, etc.; I-II generally severe also; III-IV prevailing northwest winds Manitoba-Atlantic bringing cool temperature from the interior; temperature negatively influenced by the over-blown ice masses of the lakes.

SUMMARY

The two generally severest months in Manitoba (January and February) are of enormous influence on the immediately following March-April eastward; the very close connection enables one to give in future two reasonable forecasts for these months for the whole area of the Great Lakes region and New England. The correlation $r = \leq 0.60$ covers an area about twice the size of Germany.

EDITOR'S NOTE.—In a recent communication Mr. Groissmayr indicates that he has discovered a relation between spring temperature at Dawson, Alaska, and the immediately following summer temperature in the middle Mississippi Valley. He expects to favor readers of the REVIEW with a note on the subject in a few months.—A. J. H.

WEATHER ABNORMALITIES IN THE UNITED STATES (SIXTH NOTE): TEMPERATURE DISTRIBUTION

By ALFRED J. HENRY

[Weather Bureau, Washington, June, 1930]

The monthly mean temperature distribution with respect to departures from the normal is shown on Chart III of this REVIEW. The shaded areas represent departures above the normal and the unshaded areas represent departures below the normal.

Anyone who has observed Chart III month by month must have noticed that normal temperature seldom occurs in any month except along a more or less arbitrary line drawn on the chart to separate districts having negative departures from those of opposite sign. The monthly mean temperatures along the zero line or line of no departure from the normal is approximately normal.

It may have been observed also that months when the mean temperature anomaly is in the same sense over the whole country are of rather infrequent occurrence. The most frequent distribution is a mixed one, some areas having a positive departure and others a negative. The purpose of this paper is to explain so far as is possible the occurrence of sharply contrasted anomalies.

The Rocky Mountains as a climatic divide.—The Rocky Mountains at times act as a climatic divide, especially as to temperature, and the reason is not far to seek. It has been established that the flow of polar air equatorward takes place along and near to the surface of the ground, say up to 3,000 to 4,000 feet. Since the summits of the Rocky Mountains are generally at a greater altitude than the above figures and since the cold air generally flows equatorward along the east slope of the mountains the range serves as a barrier to prevent the overflow of cold air to the areas west of the mountains. There are other factors which in connection with the barrier effect operate to keep temperature west of the mountains at a higher level on occasions than air to the east of the mountains. These factors are in the main, the place of origin and direction of movement of cyclonic systems and areas of high pressure (anticyclones); these in turn are controlled by the pressure distribution over large areas remote from the west coast of the North American continent. The lack of adequate meteorological data from the vast water surface between the Asiatic continent and North America makes it difficult to place ones finger upon the controlling cause or causes of origin and any tentative explanation that may be offered must be largely speculative. It is only within very recent years that meteorologists have been able to

gain any knowledge of the pressure distribution over the North Pacific.

Consider first the condition *warm east, cold west of the Rockies*: This condition has been found in 6 winter months out of a total of 111 in the last 37 winters; it is therefore a phenomenon of rather infrequent occurrence.

In the best-developed type, that of December, 1928, for example, the current pressure distribution for the month was considerably below normal in the Aleutian and Gulf of Alaska areas and above the normal over the middle part of the North Pacific from approximately the longitude of Midway Island, 177° west longitude, to the western part of the United States. That pressure distribution leads to the inference that cyclonic systems would, as they did, develop and move across the North American continent in relatively high latitudes; the inference is also permitted that by reason of high pressure over western United States, secondary cyclones would develop over the southern plateau and this inference also was realized. The development of cyclonic storms over that region tends to create a flow of cold air southward over the territory west of the Rockies. Finally, as it happened, but we do not know the reason why, there were no strong anticyclones in that month with their associated flow of cold air to the southward which takes place in a normal winter month, but rather nearly all of the anticyclones of the month developed near the Canadian border but within the United States and naturally they did not bring very much reduction in the temperature.

Most of the six cases studied had the common feature of low pressure in the Aleutians and high pressure over western United States as well as over the Pacific between Honolulu and the California coast.

The reverse condition, viz, *warm west, cold east of the Rockies*, will follow when many cyclonic systems pass inland from the Pacific over British Columbia and move thence east or southeast across the Rockies. Cyclones so moving cause a flow of warm oceanic air across the Pacific Coast States and the plateau region. If, now, a number of high-pressure areas (anticyclones) advance south-southeastward from Canada, the point of entry into the United States being east of the Rocky Mountains, and if the movement is continued for several days as in December, 1917, surface temperatures east of the mountains will suffer a pronounced lowering according to the magnitude of the flow of polar air.